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FOREST SERVICE AERIAL SPRAY COMPUTER MODEL FSCBG 4.3

USER MANUAL EXTENSION

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USER MANUAL EXTENSION

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INTRODUCTION

FSCBG version 4.0 was released to the user community on January 15, 1992. Since then, numerous improvements have been made as additional features were programmed into the model, and as needs were encountered by Continuum Dynamics, Inc. and other code users. All of the changes to date are present in FSCBG version 4.3, summarized in this User Manual Extension. This document is a companion to the FSCBG 4.0 User Manual (Teske and Curbishley 1991) and the FSCBG 4.0 One-On-One Instruction Manual (Teske, Curbishley and Skyler 1991). It is assumed in all that follows that the reader is familiar with these original manuals. As before, comments and suggestions regarding FSCBG and this manual extension may be forwarded to:

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FSCBG 4.3 ADDITIONAL PROGRAM FEATURES

Three significant changes have been made in this release of FSCBG:

1. The addition of "Menu Detail Level" now permits three levels of expertise for the user: "lite", standard or advanced. Most of the data input menus are modified by the level of expertise selected, although output and plotting capability remain unchanged. For the most part the menus look a bit different from those shown in the User Manual; however, users should (hopefully) have little trouble negotiating their way through data entry, and quickly find a comfortable level of expertise. This feature, particularly the selection of the "lite" menu expertise, should make the running of FSCBG much easier for the inexperienced, or occasional, user. All levels of expertise have access to an automatic receptor grid generator.

2. The Help facility is activated. The entire User Manual (and more) is contained in a companion program help file. Users may never have to read the manuals again.

3. The handoff from near-wake calculations to dispersion may be manipulated by the user to extend near-wake to the ground, with more drop sizes (up to 100), greater precision in the drop size distribution, and more nozzles (up to 60). Graphical output from near-wake is more detailed, and more flexible. This version of FSCBG contains the full power of AGDISP mod 6.0.

Other features, carried over from versions 4.1 and 4.2 and modified to accommodate the above changes, include the following:

4. DOS operating system interface for file names
5. Interactive libraries
6. Separate mass size library entries for small drop sizes
7. Mass size distribution manipulation
8. Collection efficiency added to discrete receptors
9. Net radiation index computation
10. Evaluation of Swath Width
11. Calculation of Total Accountancy of released material
12. Pie charts and bar charts for Total Accountancy results
13. Font selection for graphical output
14. Saving plotting parameters
15. Data export to commercial graphics programs or data packages

FSCBG 4.0 USER MANUAL CHANGES

Additional clarification is in order on the procedures to invoke to achieve Graphics Hardcopy, establish good Receptor Grid Geometry and Source Lines, and recover nonvolatile pesticide deposition with nonvolatile tank mix additives.

Graphics Hardcopy Destination:

```
EC Setup>H/C Dest

          Graphics Hardcopy Destination

     A-Std Output
     B-Disk File
     C-Comm 1
     D-Comm 2
```

The available graphics destinations are displayed. The selection of Standard Output will send graphical results to the screen. The selection of Disk File will write results into a disk file. The selection of Comm 1 or Comm 2 will send graphical results to the display devices connected to the communication (serial) ports. At present the only way for graphical results to be displayed on a dot-matrix printer is by invoking "print screen" (with the DOS GRAPHICS command resident).

Hardcopy Plot:

Selection of Hardcopy Plot (in various menus) gives the user the option of typing in a filename (assuming Disk File has been chosen as the appropriate hardcopy destination in Setup). If, at this point, the user types in LPT1 as the filename, the plot will be sent directly to the hardware device attached to the parallel printer port (only Tektronix, HP Plotter and PostScript devices, as selected in Setup under Graphics Hardcopy Device, work here). If the user types in a filename, or chooses to keep the default filename that appears, a disk file will be created with the appropriate plot information in it. After exiting FSCBG, the user can then send the plot to the hardcopy device by using either the DOS COPY or PRINT commands (for example, COPY filename LPT1). Some users have encountered a problem with some PostScript printers; in these cases the User Group will supply an additional program that filters the plot file through the communications port to recover the printed plot.

Receptor Geometry:

As a general rule-of-thumb, if the user is attempting to predict deposition on a target area, a receptor should be placed directly under each flight line, and at least one receptor should be placed between each flight line. Additional receptors may be added if the swath width exceeds 30 m. The reason for this recommendation is that drops larger than 150 micrometers will generally fall near the spray swath, depending of course on meteorological conditions. If enough receptors are not placed under the aircraft, the deposition there will be recovered incorrectly.

An example of a good receptor grid for measuring deposition on-target and drift downwind would be to place a receptor under each flight line and one or more receptors (placed uniformly across the swath width) between each flight line. This pattern would be continued downwind for a given distance, then every 30 m downwind, then every 60 m downwind, and then every 100 m or more downwind for as far as the user expects the material to drift.

Great care must be taken in establishing a receptor grid. If the release height is close to the ground (less than 2 m), larger drops in the drop size spectrum may deposit well before the next receptor grid point (away from the flight line) is reached. It is therefore strongly recommended that the user examine the near-wake plot of Continuous Deposition (for Total of All Drop Categories) to interpret the level of deposition recovered on receptor grid points adjacent to the flight lines. This near-wake plot indicates what a single swath deposition pattern looks like, and should enable the user to add grid points to describe the deposition pattern correctly.

In the "lite" level of expertise, FSCBG automatically generates a receptor grid, given the Source Geometry specified by the user. This feature is an option in standard and advanced levels of expertise.

In previous versions of FSCBG all source lines (flight lines) had to be in the same direction (racetrack configuration only). This restriction is actually needed only for near-wake calculations involving propeller-driven aircraft, and so version 4.3 relaxes this requirement accordingly.

Source lines not aligned with the receptor grid may generate some very interesting contour plots, especially close to the source lines themselves, because grid points are not consistently the same distance from the source lines. Also, edge effects (near the beginning and ending of the

source lines) may produce other interesting contour plots; these results are actually under review and will be corrected when the issues they raise are resolved.

Nonvolatile Deposition:

If the user wishes to recover the nonvolatile pesticide deposition from a tank mix that contains nonvolatile additives as well, the Active Fraction of Carrier should be entered in the Spray Material menu:

```
BG (S)Data>Spray Mat

              Spray Material

            A-Name
            B-Density of Carrier                .9970 g/cm3
            C-Volatile Fraction of Carrier      .9000
            D-Active Fraction of Carrier    .2000E-01
            E-Mass Size Distribution
            F-Spray Material Library
```

In this menu (standard is shown) item D identifies the Active Fraction, and represents the amount of active material present in the tank mix (obviously, the Active Fraction cannot be larger than the Nonvolatile Fraction). Suppose, for example, that the nonvolatile pesticide fraction is 0.02 (as shown above) and that the total nonvolatile fraction (including the nonvolatile tank mix additives) is 0.1. The value entered in the Spray Material menu as the Volatile Fraction of Carrier is then 0.9, while the Active Fraction of Carrier is entered as 0.02. All graphics outputs have been modified to include the ability to plot Total, Nonvolatile, and Active fractions.

The user should be aware that the suggestions made in the version 4.2 user manual extension regarding active fraction no longer apply, with the addition of Active Fraction of Carrier to the Spray Material menu, i.e., the Emission Rate entered into FSCBG should now always represent the total spray emission rate.

1. MENU DETAIL LEVEL

Setup now contains the additional entry (placed at the top of the list):

```
E Setup

                Machine-Specific Setup

              A-Menu Detail Level                 Standard
              B-Device for Graphics Display       VGA
              C-Device for Graphics Hardcopy      PostScript
              D-Graphics Hardcopy Destination     Disk File
              E-Graphics Display Color Option     Color
              F-Graphics Hardcopy Color Option    Color
              G-Delimiter Character for Export    <space>
              H-Save Setup
```

where Menu Detail Level specifies the level of expertise of the user for data entry into FSCBG. The submenu reads:

```
EA Setup>Menu Detail

                Menu Detail Level

              A-"Lite"
              B-Standard
              C-Advanced
```

At this menu the user may select his or her level of expertise. Advanced level permits access to ALL the features in FSCBG (hence, all previously generated files from FSCBG are designated "Advanced" files). Standard level assumes the following restrictions from Advanced:

Model Selection: no change
Receptor Geometry:
    Grid Orientation Angle = 0.0 deg
    Discrete Receptors = default flat card
Canopy Description: no change
Aircraft Description: no change
Spray System: no change
Spray Material:
    Material Half Life = infinite
    Carrier Type = water
    Mass Size Distribution: library options restricted
    Minimum Drop Diameter = 5 microns

Physical Constants: not available
Source Geometry: no change
Meteorological Data:
Vortex Decay Coefficient = 0.56 m/sec
Override Inputs: not available

"Lite" level assumes the following restrictions from Standard:

Model Selection:
Aircraft Wake = Near Wake
Canopy: not available
Receptor Geometry:
Receptor Grid Height: one entry only
Receptor Grid: automatically generated
Discrete Receptors: not available
Canopy Description: not available
Aircraft Description:
Aircraft: library options only (boom height and flying speed are selected from the library)
Spray System:
Number of Nozzles: only entry available (nozzles are positioned uniformly between the 3/4ths semispan distance with Forward Locations = 0.0)
Spray Material:
Density of Carrier = 1.0 gm/cu cm
Mass Size Distribution: library options only
Source Geometry:
Spraying Speed: from Aircraft Library
Source Locations: regularly spaced entries
Meteorological Data:
Surface Pressure = 1013.0 mb
Net Radiation Index = 1
Open Terrain: one entry each for height, temperature, relative humidity, wind speed, and wind direction
Within Canopy: not available
Compute Net Radiation Index: not available

When the user changes menu detail level in the program, a warning screen will appear, asking for verification of the change. The user is hereby cautioned: increasing menu detail level will not affect ANY inputs currently in the program, but DECREASING MENU DETAIL LEVEL MAY SEVERELY IMPACT EXISTING INPUT. To cite one example: if a standard or advanced run has a canopy, the selection of "lite" will

eliminate the canopy; and a return to standard or advanced will find that the Canopy option is NOT selected. Also, just because the user moves down to "lite" does not mean that the program will rerun anything. In fact, if the user does not change source lines or number of nozzles, the original entries will be RETAINED and NOT OVERWRITTEN. If the "lite" version does not require a rerun of the dispersion module, the receptor grid will NOT be automatically generated.

All FSCBG input files carry a flag designating their menu detail level. If the creation level of a file is different from the current menu detail level in FSCBG, a warning screen will appear before the file is read. If the user proceeds with the file entry, the current menu detail level will be CHANGED to the level existing in the input file.

Receptor grid generation is available to standard and advanced users (it is automatically invoked with "lite" users) with a new entry line in the Receptor Grid menu:

```
BCB Data>Recep>Grid

              Receptor Grid

          A-Grid Heights(s)                    1
          B-Grid X Location(s)                17
          c-Grid Y Location(s)                25
          D-Create Regular Grid
          E-Auto Generate Grid        no
```

An entry of "yes" to Auto Generate Grid will force grid generation at computation time. When the receptor grid is generated, the preview plot for Receptor Grid and Flight Lines will show the generated grid ONLY IF THE DISPERSION CALCULATION HAS BEEN RERUN for the new grid.

After a little trial and error, all users should feel comfortable with this new feature in FSCBG. Because of the reduced number of inputs needed to run FSCBG, the "lite" version should be a good first choice when returning to the program after a long absence, or running the program for the first time.

2. HELP

A complete Help facility is now available in FSCBG. At nearly every entry in the program (with the highlight bar on a menu item), typing the question mark ("?") will invoke Help for the highlighted menu item. Once the Help screen is activated, the user will notice the options (I)ndex and (O)riginal on the third line of the screen. By entering "i", Help will display Main Topics down the left side of the screen, and Subtopics down the right side of the screen when a main topic is selected. Movement through the Main Topics and Subtopics is possible with the arrow keys, and page-up and page-down. Selection is made with the < return > key.

Entering "o" will return Help to its original topic, and <esc> will return to the highlighted menu item.

3. NEAR WAKE HANDOFF

One of the important extensions in FSCBG is the ability to carry the Lagrangian solution further toward the ground with greater precision. The following features have been added:

1. The Calculations screen has an added menu item F:

```
C Calc

                Calculations

              A-Do Calculations
              B-Check Data Only
              C-Force All Calculations
              D-Print Inputs Only
              E-Print Options
              F-Calculation Options
```

Within Calculation Options is:

```
CFA Calc>Calc Opts>NW Hnd

                Select Near Wake Handoff

              A-Vortex Decay
              B-Canopy Top
              C-Ground
              D-Four Sigma Canopy Top
              E-Four Sigma Ground
```

Option A - Vortex Decay is the default option for "lite" and the way all previous FSCBG calculations were run. If a canopy is present, the user may select Canopy Top to force the near-wake calculation to the top of the canopy; Ground brings the near-wake calculation all the way to the ground. Previously, if the wingtip vortices decayed sufficiently, the near-wake calculation would end before spray material deposited completely at the canopy top or on the ground; Options B and C now force FSCBG to carry the Lagrangian solver further. Note: "Canopy Top" and "Ground" are always superceded by the maximum height of the receptor grid and all discrete receptors.

Options D and E, on the other hand, stop the near-wake Lagrangian solver before any spray material begins to intercept the Canopy Top or Ground, respectively. It is then expected that the Gaussian Dispersion

module would be used to generate the ground deposition. The drawback of this approach is that the wingtip vortices may not have decayed sufficiently before the Gaussian solution is invoked (the Gaussian solution does not include the vortical effect). What we have here is a tradeoff -- Options B and C to permit the Lagrangian solver to generate the answer completely, or Options D and E to permit the Gaussian solver to generate the answer completely. There are pros and cons for either approach, and the user should be aware of them when running FSCBG.

2. The maximum number of drop size categories has been increased to 100.

3. The maximum number of nozzles has been increased to 60.

The near-wake time step algorithm has been improved for greater speed, and the saving of information in the near-wake binary files has been improved to reduce file sizes. Nevertheless, IT IS NOW POSSIBLE FOR FSCBG TO CRIPPLE EVEN A 486-BASED PERSONAL COMPUTER. The user is cautioned when running with many drop size categories, many nozzles, and many source lines. Scoping calculations (with fewer drop sizes, nozzles and flight lines) may save considerable computation time in the preliminary stages of a calculation.

Also, for the record, the near-wake aircraft wing or rotor load distribution model has been changed from rectangular to elliptical to reflect recent improved comparisons with ground deposition data across buffer zones.

4. DOS INTERFACE

FSCBG now permits the user to access the operating system to recover Family Names. The Files menu has been modified:

```
A Files

                Data File/Family Operations

          A-Open ...
          B-Save As ...
          C-Import FSCBG 3.XX Data
```

When options A and B are invoked, the current directory is examined, and all applicable DAT file names are displayed on the screen (even DAT files not generated by FSCBG). The user may move through the list with the arrow keys to locate the file desired. A < return > either opens the file or saves results into the file. Alternately, the user may examine the list, then backspace to remove any file name present on the second line on the screen, and enter an appropriate file name.

5. INTERACTIVE LIBRARIES

FSCBG now includes interactive libraries. The libraries that exist in the program are:

FSCBG.ACL	Aircraft
FSCBG.CNL	Canopy
FSCBG.MSL	Mass Size Distribution
FSCBG.MTL	Meteorological Data
FSCBG.RGL	Receptor Geometry
FSCBG.SGL	Source Geometry
FSCBG.SML	Spray Material
FSCBG.SSL	Spray System

Default entries for these libraries are provided on the distribution diskette. The binary structure of the Aircraft and Mass Size Distribution libraries has been changed from FSCBG version 4.2; consequently, the user should copy the new FSCBG.ACL and FSCBG.MSL libraries over the old ones distributed with previous versions of FSCBG. Later versions of FSCBG will only UPDATE these libraries; therefore, it is important for each user to maintain these libraries on his or her hard drive, even if they contain empty information.

Each of the libraries is accessed similarly. Each now contains the ability to name the contents of their entries. When the user invokes any library, these names are displayed in alphabetical order. At this point the third line on the screen reads:

```
? help  <esc> go back (V)iew (U)se (A)dd (D)elete (G)oto
```

where:

- v permits viewing of the entry (< return > also does this)
- u indicates that the user wishes to transfer the current library entry into the program
- a indicates that the user wishes to add the current program data to the library
- d indicates that the user wishes to delete the current library entry from the library
- g permits the user to jump to a specific location in the library name display

With the options u , a , and d the third line on the screen will then read:

```
? help  <esc> cancel  (Y)es (N)o
```

where:

y invokes the intended operation
n cancels the intended operation (< esc > also does this)

The user should manipulate all library entries with caution, as each library can now become very personalized, and keep the distribution diskette available to recover the original libraries if necessary.

To accommodate the ability to name the entries in the library, changes are necessary in the following menus:

Receptor Geometry:

```
BC Data>Recep

                Receptor Geometry

              A-Name
              B-Receptor Grid
              C-Discrete Receptor(s)
              D-Receptor Library
```

Canopy Description:

```
BD Data>Canopy

                Canopy

              A-Name
              B-Story/Foliage Canopy Data
              C-Canopy Library
```

Spray System:

```
BF Data>Spray Sys

                Spray System

              A-Name
              B-Nozzle Forward Location(s)
              C-Nozzle Horiz/Vert Location(s)
              D-Spray System Library
```

Spray Material:

```
BG Data>Spray Mat

                Spray Material

              A-Name
              B-Density of Carrier
              C-Volatile Fraction of Carrier
              D-Active Fraction of Carrier
              E-Mass Size Distribution
              F-Spray Material Library
```

Mass Size Distribution:

```
BGE Data>Spray Mat>Mass Size Dist

                Mass Size Distribution

              A-Name
              B-Specification
              C-Mass Size Distribution
              D-Mass Size Distribution Library
```

Source Geometry:

```
BH Data>Src Geom

                Source Geometry

              A-Name
              B-Spraying Speed
              C-Release Height
              D-Emission Rate
              E-Swath Width
              F-Source Location(s)
              G-Add Regularly Spaced Sources
              H-Source Geometry Library
```

Meteorological Data:

```
BI Data>Met

                Meteorological Data

              A-Name
              B-Surface Pressure
              C-Net Radiation Index
              D-Open Terrain
              E-Within Canopy
              F-Compute Net Radiation Index
              G-Meteorological Data Library
```

6. SMALL DROP SIZE LIBRARY ENTRIES

The Mass Size Distribution library now contains the unmanipulated data found in Skyler and Barry (1991), in addition to 21 distributions with drop sizes below 34 microns (from Yates and Cowden 1987), identified by an asterisk (*) after the material information on the entry name. All data in the library adds to a total mass fraction of 1.0, except for the drop size data below 34 microns, which represents only a portion of more complete distributions. The entry name in the Mass Size Distribution library includes: nozzle type; spray material; airstream angle (deg) or rpm; and aircraft spraying speed (mph).

7. MASS SIZE MANIPULATION

When the u option is selected for the Mass Size Distribution library, the third line on the screen will read:

"Lite":

```
? help <esc> cancel (Y)es (N)o
```

where "yes" will overwrite the current mass size distribution with the library entry.

Standard:

```
? help <esc> cancel (Y)es (N)o (M)erge
```

where the merge option permits drop size categories to be combined, by accessing a further menu:

```
          Merge Drop Categories

A-Number of Categories                    15
B-Output Average Diameters        yes
C-Generate Categories & Continue
```

where the MAXIMUM number of categories is shown initially (the user may reduce this number BUT NOT INCREASE IT). Option B permits the program to create average diameters from upper diameter information. Option C invokes the selected features and continues to verification of the merged mass size distribution.

Advanced:

```
? help <esc> cancel (Y)es (N)o (M)erge (C)urvefit (I)nterpolate
```

where the first additional option permits curve-fitting of the mass size distribution to a root-normal distribution (Simmons 1977; Teske and Barry 1992), by accessing a further menu:

```
Curvefit Drop Categories

A-Minumum Drop Diameter              56.00 micron
B-Maximum Drop Diameter             512.00 micron
C-Drop Size Growth Factor             1.05
D-Number of Categories                  15
E-Output Average Diameters          yes
F-Generate Categories & Continue
```

where the default entries are from the existing library data. The growth factor multiplies a previous drop size increment to create a new drop size increment (at a larger drop diameter). FSCBG computes the initial drop size increment to make it all come out. The number of categories may be as large as 100. Generating categories rolls into a computation screen and then to verification of the curvefitted mass size distribution.

The other additional option permits interpolation of the mass size distribution, by accessing a further menu:

```
Interpolate Drop Categories

A-Incremental Mass Fraction          .2000E-01
B-Output Average Diameters          yes
C-Generate Categories & Continue
```

where the Incremental Mass Fraction suggests that no drop size category has a mass fraction LARGER than this amount. Volume interpolation would be invoked to split drop size categories to achieve this effect, keeping the number of drop sizes below 100 (to the point of overriding the Incremental Mass Fraction entered here). Generating categories rolls into a computation screen and then to verification of the interpolated mass size distribution.

8. DISCRETE RECEPTORS

FSCBG now expands the role and function of the discrete receptors by permitting them to acquire specific collector attributes. The discrete receptor menu (advanced level only) contains eight entries per receptor:

0. Receptor number (1 to 100) that always stays on the screen.
1. Collector Type:
    1: default flat card with 100 percent collection efficiency
    2: flat card or ribbon
    3: cylinder
    4: sphere
2. X receptor location
3. Y receptor location
4. Z receptor location (height)
5. X outward normal
6. Y outward normal
7. Z outward normal
8. Characteristic size: width of collector type 2, or diameter of types 3 and 4

The (X,Y,Z) outward normal values identify the receptor direction for collector types 2, 3 and 4. X and Y correspond to the Receptor Grid directions entered by the user; Z is vertically upward. For example, if collection is to take place on the top of a flat surface, the outward normals would be (0,0,1); if collection is to take place on the upwind side of the collector, and the wind is blowing left to right (minus X to plus X), the outward normals would be (-1,0,0).

Entries of (X,Y,Z) outward normals and characteristic size for collector type 1 are not used in FSCBG. Although collector types are entered with real numbers (with decimal points), they are converted to integers upon exit from the Discrete Receptor menu.

The tabulated values scroll horizontally to accommodate the extra columns of data. Pressing the left or right arrow keys will cause the table to shift left or right as the cursor reaches the edge of the display.

Collection efficiency is determined by evaluating a Stokes parameter involving the density of the spray material, its drop size and velocity toward the collector, and interpolating within the experimental curves of May and Clifford (1967).

9. NET RADIATION INDEX

The Meteorological Data menu (advanced level only) appears as:

```
BI Data>Met

                Meteorological Data

            A-Name
            B-Vortex Decay Coefficient
            C-Surface Pressure
            D-Net Radiation Index
            E-Open Terrain
            F-Within Canopy
            G-Override Inputs
            H-Compute Net Radiation Index
            I-Meteorological Data Library
```

Option H permits the user to enter field data and let FSCBG compute Net Radiation Index appearing as Option D. The new menu becomes:

```
BIH Data>Met>NetRad

                Compute Net Radiation Index

            A-Date (MMDDYY)                    90490
            B-Time (HHMM GMT)                   1705
            C-Cloud Cover                       15.0 %
            D-Cloud Height                    4000.0 ft
            E-West Longitude                   74.58 deg
            F-North Latitude                   40.35 deg
            G-Compute Index and Go Back
```

Options A and B enter the Date and Time of the field test, with the time referenced to Greenwich Mean Time (including the possible effect of Daylight Savings Time). Both Date and Time must include leading zeros where needed (for days under 10 and for minutes less than 10). The time is a 24-hour clock.

Option C enters the amount of cloud cover (in percentage) and Option D estimates the cloud height. Options E and F position the field test location by entering the longitude (where west of Greenwich is positive) and latitude (where north of the equator is positive). Option G invokes the calculation and replaces Net Radiation Index with the computed value. If Option G is not invoked, the calculation will not take place.

10. SWATH WIDTH

FSCBG now permits the user to compute the anticipated Swath Width of the deposition generated from a Near Wake computation. The new Near Wake Results menu becomes:

```
DE Results>Wake

            Near Wake Plots

          A-Select Drop Category Range              1
          B-Select Dispersion Units        drops / sq m
          C-Select Dispersion Contrib      non-volatile
          D-Vertical Flux Position                .0 m
          E-Swath Width Value
          F-Plot Mean Drop Trajectories
          G-Plot Mean+Std Dev Trajectories
          H-Continuous Deposition
          I-Vertical Flux Profile
          J-Drift Fraction Time History
          K-Swath Width
          L-Swath Overlap Pattern
```

In previous versions of FSCBG, Continuous Deposition, Vertical Flux Profile and Drift Fraction Time History were computed for only the total spray material. In version 4.3 calculations may now be made for individual drop sizes, or for the Total of All Drop Categories (selecting Option A above).

Option K - Swath Width will generate a plot of Coefficient of Variation as a function of Lane Separation. A COV of 0.3, or a local minimum in the computed curve, will recover the swath width, following the discussion developed in Teske, Twardus and Ekblad (1990). Once Option K is run, Option E - Swath Width Value will be available if the user wishes to change the swath width for Option L.

Option L - Swath Overlap Pattern will generate a three-flight-line deposition pattern as a function of distance across the swath.

11. TOTAL ACCOUNTANCY

FSCBG now permits the additional Results option of computing Total Accountancy. Total Accountancy recovers two calculations: (1) the time history of the spray material released from the nozzles, in the categories of material deposited on the ground, material deposited in the canopy (if a canopy exists), material evaporated (if evaporation occurs), and material still aloft; and (2) the loss of spray material due to material deposited in the canopy (if a canopy exists) and material evaporation (if evaporation occurs) as a function of height. The revised Results menu becomes:

```
D Results

              Results

          A-Preview Plots
          B-Meteorological Plots
          C-Evaporation Plots
          D-Canopy Plots
          E-Near Wake
          F-Dispersion
          G-Total Accountancy
```

Option G leads to the menu:

```
DG Results>TotAc

              Total Accountancy Results

          A-Select Dispersion Contrib    total non-gaseous
          B-Plot Contribution vs Time
          C-Pie Chart of Final Results
          D-Bar Chart of Final Results
          E-Plot Contribution vs Height
          F-Append Results to Print File
          G-Export Results to Data File
```

Total Accountancy may be invoked for either the total material released, its nonvolatile portion (if evaporation is present), or active fraction. Options B and E give results illustrated in Figures 1 and 2.

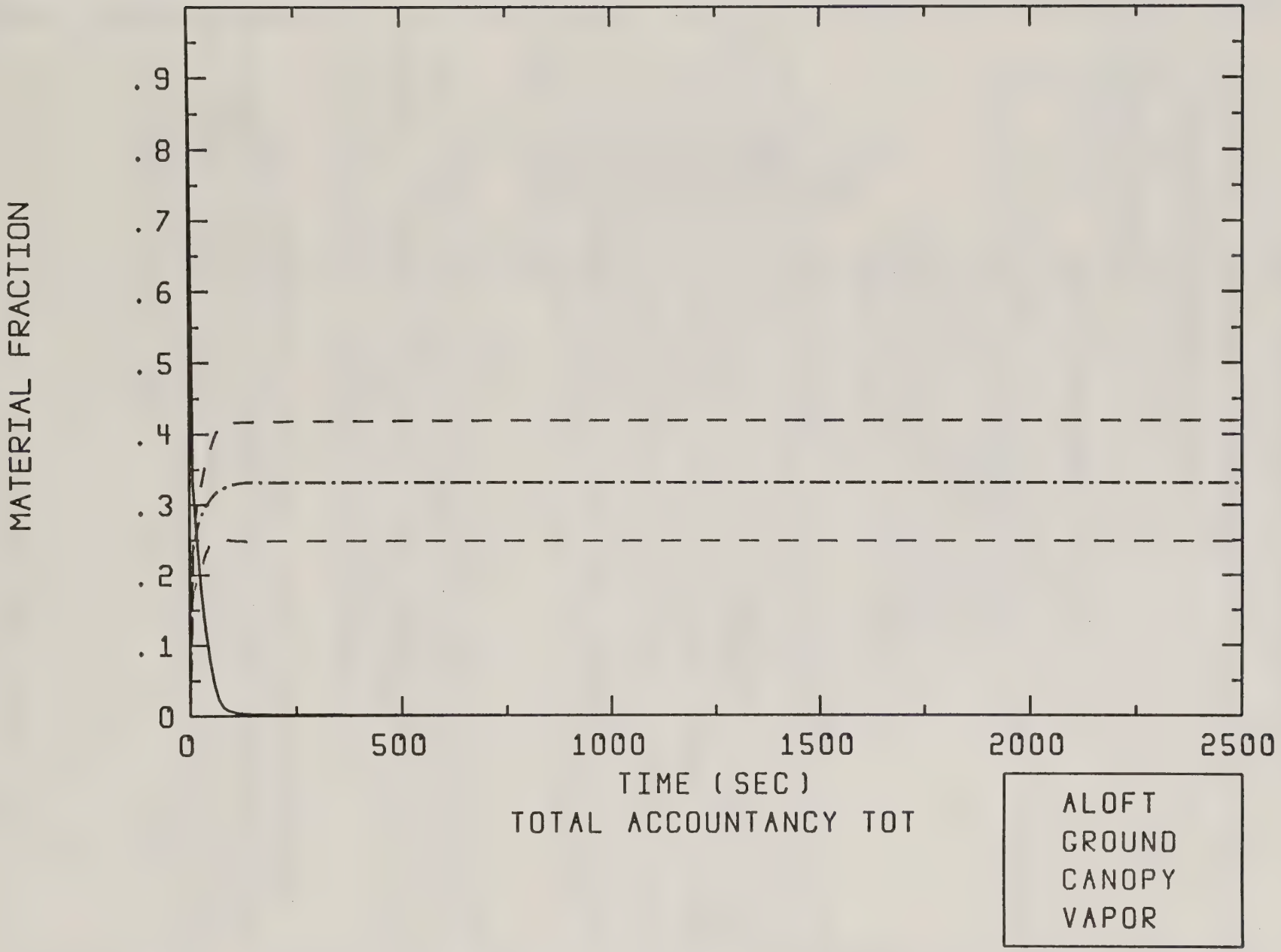

Figure 1. Example time history of Total Accountancy. The curves summarize the relative amount of spray material fraction: Aloft -- solid line; Ground -- upper dashed line; Canopy -- lower dashed line; Vapor -- dot dashed line.

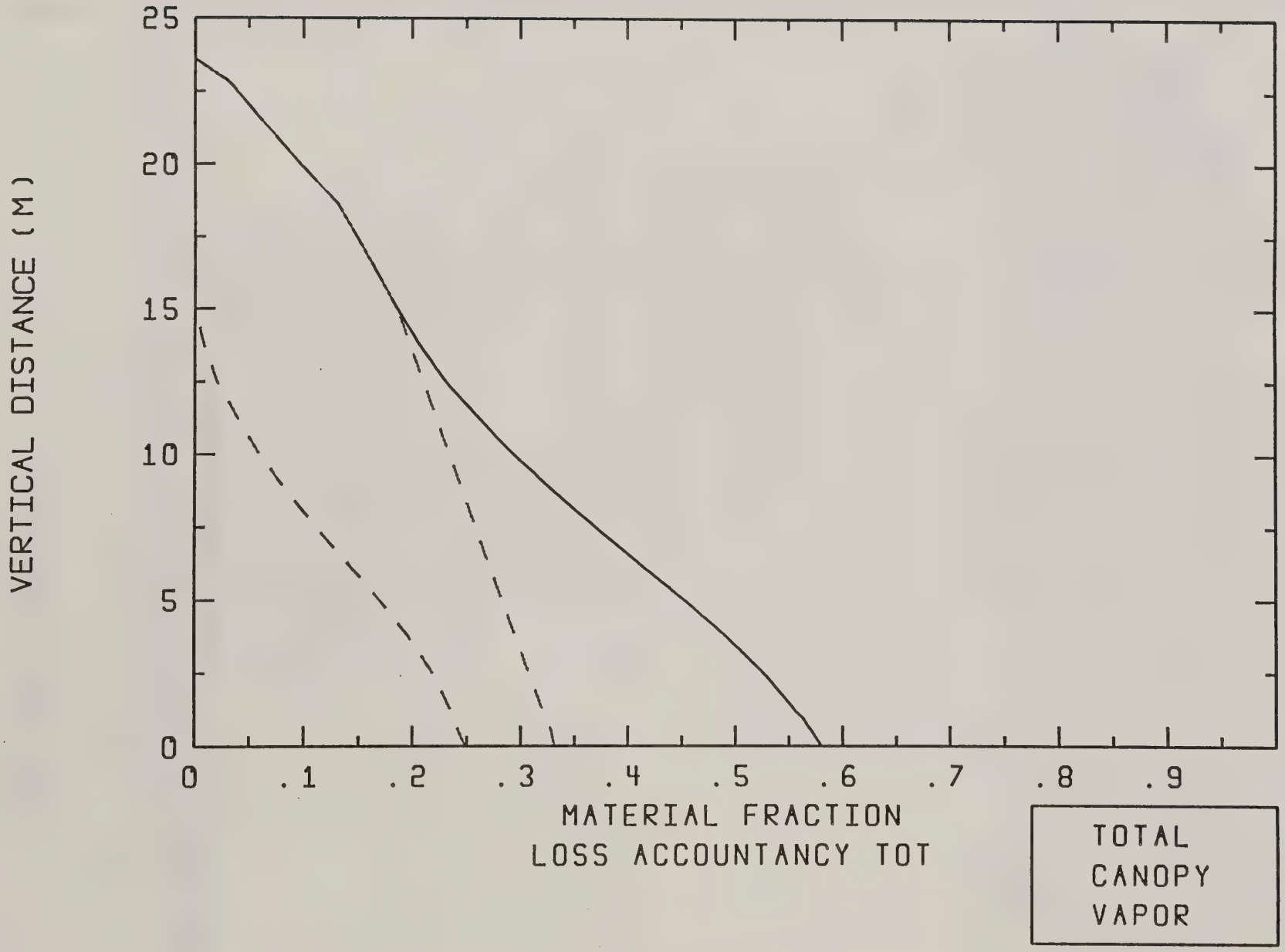

Figure 2. Example height history of Loss Accountancy. The curves summarize the relative amount of spray material fraction: Total -- solid line; Canopy -- left dashed line; Vapor -- right dashed line.

12. PIE CHARTS AND BAR CHARTS

The Total Accountancy menu is:

```
DG Results>TotAc

                Total Accountancy Results

          A-Select Dispersion Contrib    total non-gaseous
          B-Plot Contribution vs Time
          C-Pie Chart of Final Results
          D-Bar Chart of Final Results
          E-Plot Contribution vs Height
          F-Append Results to Print File
          G-Export Results to Data File
```

In addition to plotting the Total Accountancy time history (with Option B) and height profile (Option E), a pie chart (Option C) and a bar chart (Option D) of the final time history results may also be obtained. The pie chart displays the final normalized distribution of material in a pie format (Figure 3). Four slices of the pie are shown, representing material still aloft (Aloft), evaporated (Vapor), deposited on the ground (Ground), and deposited in the canopy (Canopy). All four slices are displayed even if they have a value of zero; in other words, material evaporated and deposited in a canopy are shown as zero if there is no evaporation or canopy, respectively.

The bar chart is similar to the pie chart (Figure 4), but displays the final normalized distribution of material as vertical bars whose heights represent the fraction of material in each category (material still aloft, evaporated, deposited on the ground, and deposited in the canopy). Each bar is labeled with the category and percent contribution.

The pie chart Plot Format contains a "Slice Label Character Height" that sets the height of the characters within the body of the pie chart, and an "X Label Character Height" that sets the height of the characters that form the chart label. The bar chart percentages key to the X Axis "Tic Label Character Height" entry.

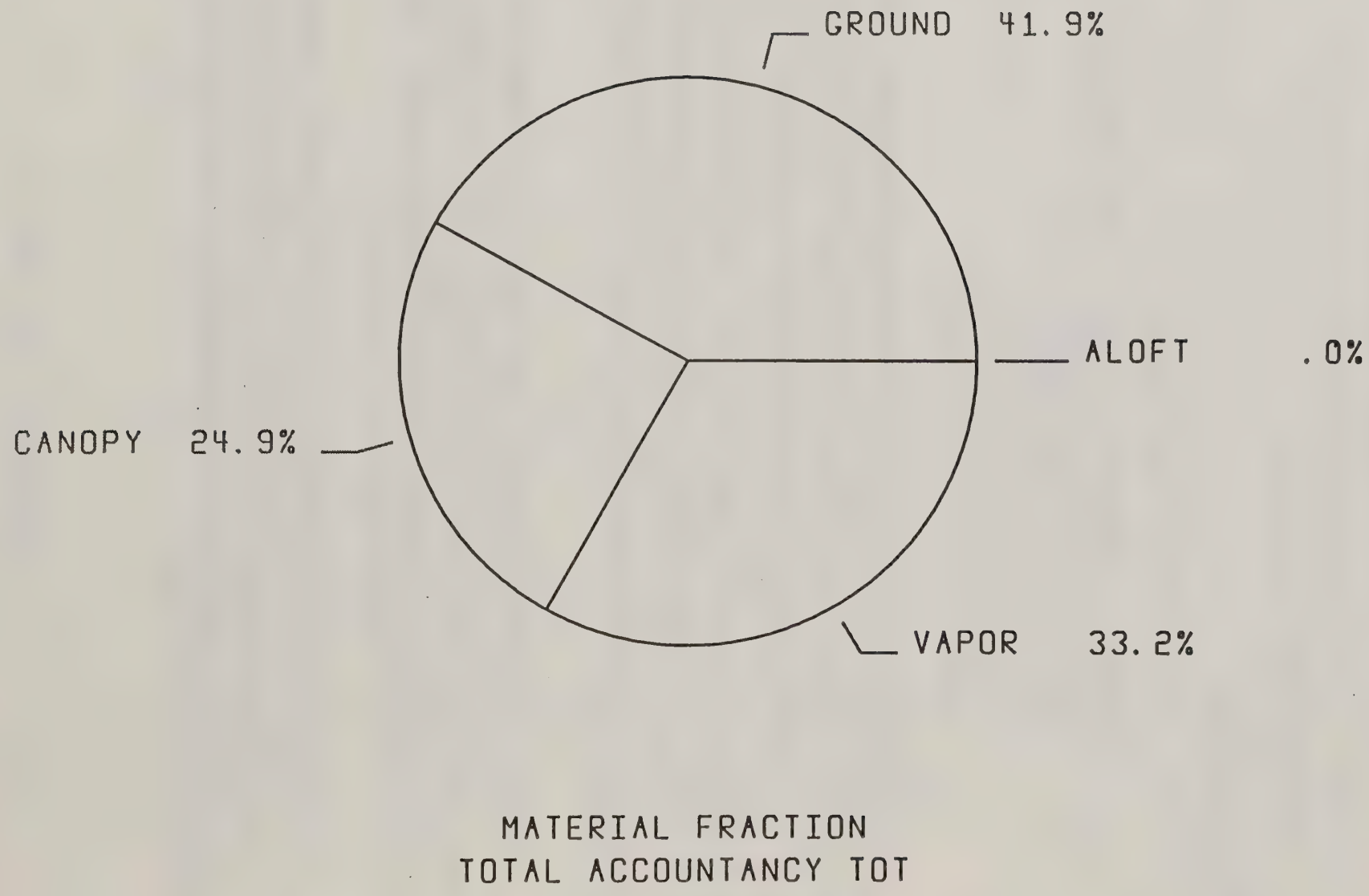

Figure 3. Example Total Accountancy pie chart of final results, displaying environmental fate of spray material in percentage of material fraction.

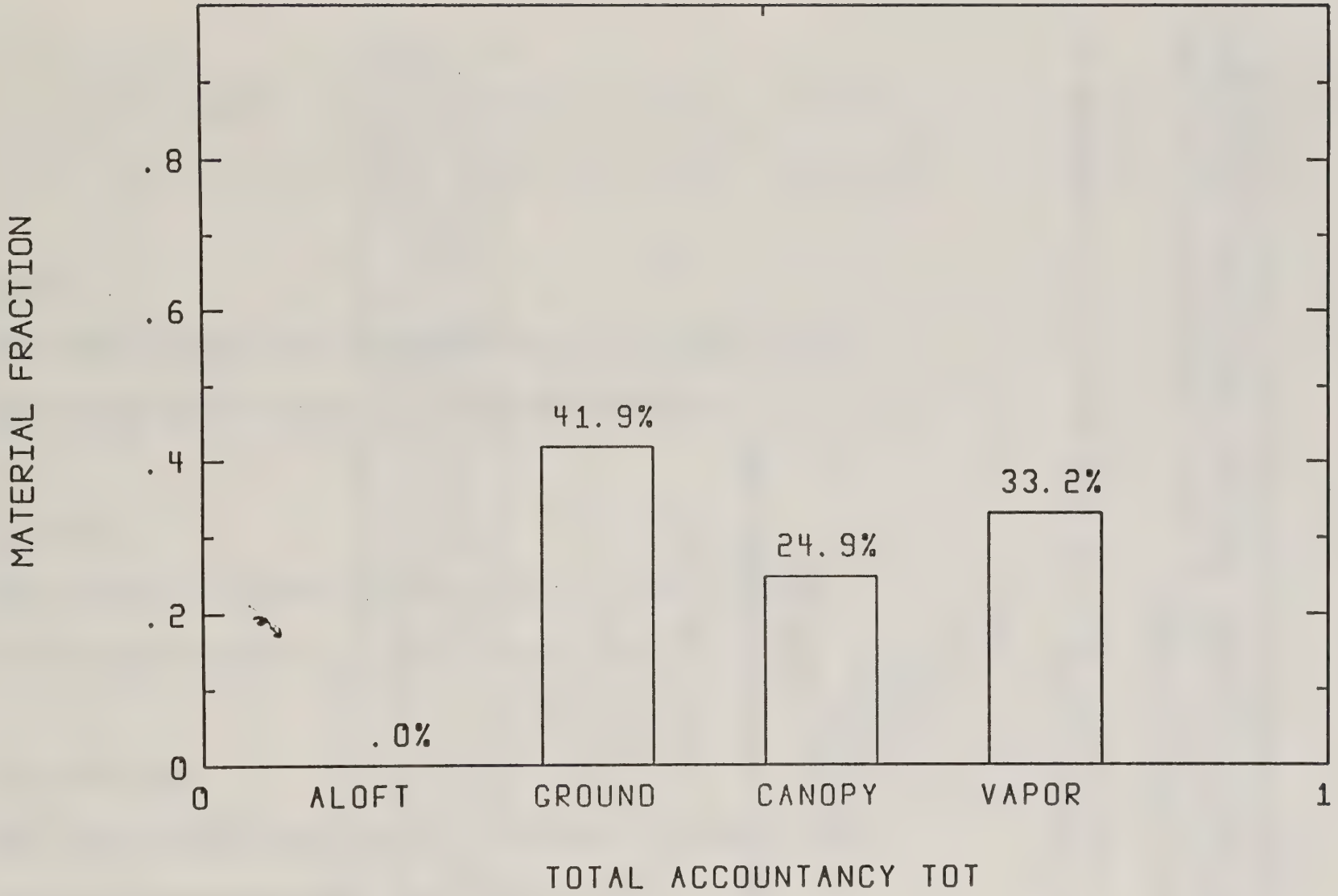

Figure 4. Example Total Accountancy bar chart of final results, displaying environmental fate of spray material in percentage of material fraction.

13. FONT SELECTION

FSCBG plots may now be displayed in three alternative fonts: Times Roman, Courier, and Avalon. These fonts dress up plots and make them look more professional; however, because of their complexity, they cause plots to take longer to complete.

The Plot Format menu has been expanded to accommodate the selection of these new fonts:

```
  Plot Format

A-X Axis
B-Y Axis
C-Legend
D-Margins
E-Font
F-Save Settings
```

Option E displays the available fonts:

```
  Select Text Font

A-default
B-Times Roman
C-Courier
D-Avalon
```

The original font is retained by FSCBG and is identified as the default font (Option A). Font characteristics are shown in Figure 5. Because of the construction characteristics of the new fonts, they will appear smaller than the default font set to the same size. The user may find it necessary to increase the character heights of the titles and labels when using one of the new fonts.

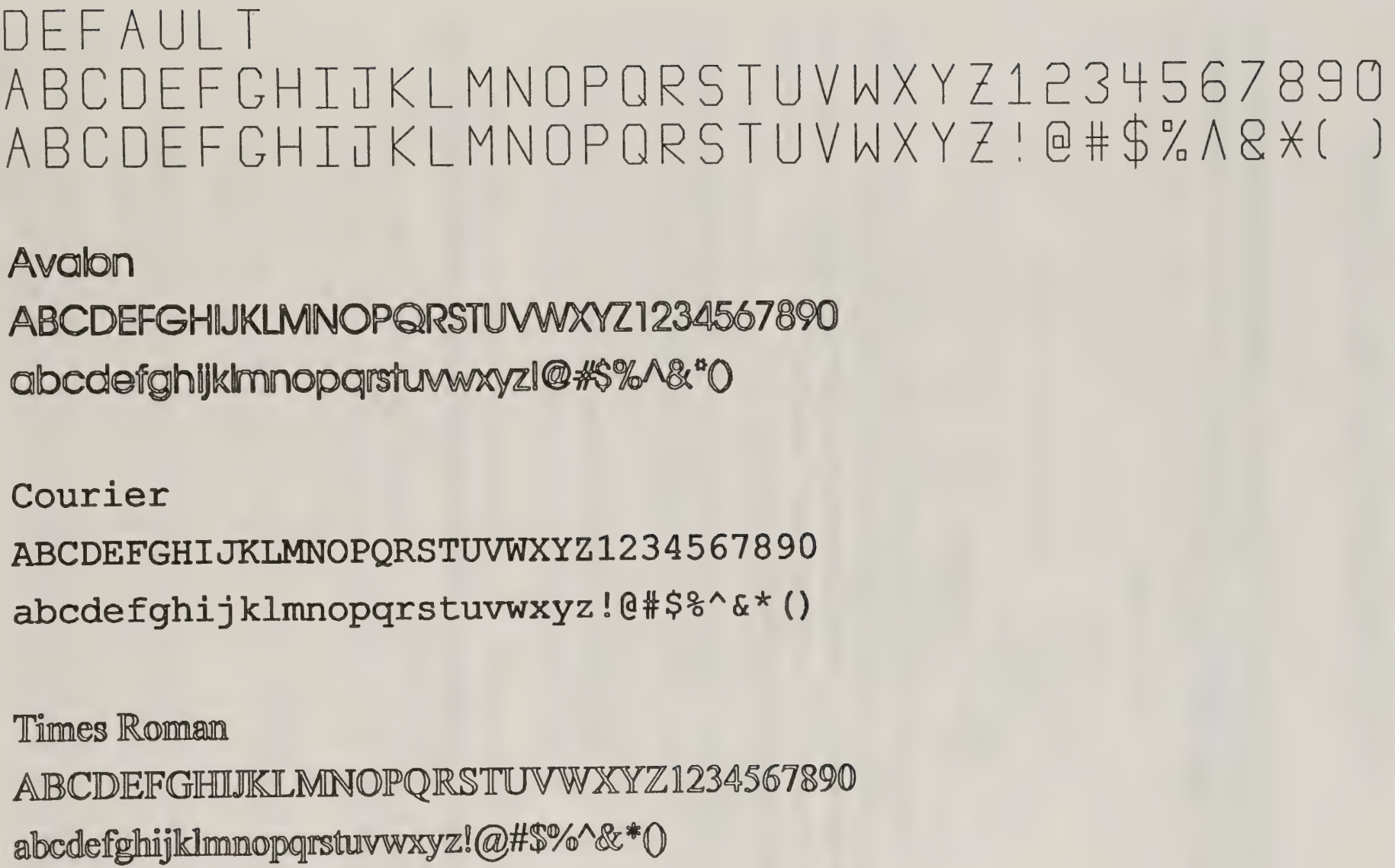

Figure 5. Font types available in FSCBG: default; Avalon; Courier; and Times Roman.

14. SAVING PLOTTING PARAMETERS

FSCBG now permits the user to save the plotting parameters (margins, character heights, scaling parameters, etc.) by invoking Option F from the revised Plot Format menu:

```
Plot Format

A-X Axis
B-Y Axis
C-Legend
D-Margins
E-Font
F-Save Settings
```

In response to this option FSCBG creates the file FSCBG.PFG and saves the current plotting information in it. Whenever FSCBG is invoked, the program will read this file and set the plot characteristics accordingly. If for some reason the user finds it necessary to return to the default settings, the easiest solution is to delete this file.

FSCBG now also permits the user to modify the height of the plot legend with Option C in the Plot Format. This option leads to:

```
A-Legend Text
B-Legend/Title Character Height       .1500
```

```
Legend Text:
```

Option A permits the user to change the legend text, and Option B, the legend character height.

15. DATA EXPORT

FSCBG now enables export of computed results into a data file, for later import by the user into commercial data manipulation or graphics packages such as Lotus 1-2-3 or Harvard Graphics. The Setup menu has been modified:

```
E Setup

                Machine-Specific Setup

A-Menu Detail Level                 Standard
B-Device for Graphics Display       VGA
C-Device for Graphics Hardcopy      PostScript
D-Graphics Hardcopy Destination     Disk File
E-Graphics Display Color Option     Color
F-Graphics Hardcopy Color Option    Color
G-Delimiter Character for Export    <space>
H-Save Setup
```

New menu Option G permits the user to specify a single character representing the delimiter between columns of exported data. The default is a single space (" "). Some graphics packages require a TAB character (which, when displayed here, will look like "<tab>"). Unprintable delimiters will be displayed as "^" followed by a letter; printable delimiters will be displayed by the printable character. If the delimiter will never change, the user should Save Setup after selecting the delimiter.

All of the options (in various menus) to "Export Results to Data File" are now active. These include the following:

1. Near Wake Continuous Deposition, with a two-column format of horizontal distance (in user-selected length units) and deposition (in user-selected deposition units).

2. Near Wake Vertical Flux profile, with a two-column format of vertical distance and flux.

3. Near Wake Drift Fraction time history, with a two-column format of time (in seconds) and drift fraction (no units).

4. Swath Width Coefficient of Variation, with a two-column format of lane separation (in user-selected length units) and COV (no units).

5. Swath Overlap Pattern, with a two-column format of horizontal distance and deposition.

6. Receptor Grid results, with a four-column format of grid X, Y and Z locations and dosage, concentration or deposition.

7. Discrete Receptor results, with a four-column format of X, Y and Z discrete locations and dosage, concentration or deposition.

8. Total Accountancy results, with a five-column format of time (in seconds), material fraction aloft, fraction deposited on the ground, fraction deposited in the canopy, and vapor fraction aloft; and a four-column format of height, total material fraction lost, fraction lost to canopy impaction, and fraction lost to evaporation.

The user is expected to remember the units of the column results saved in the export files, as they are not written into the file.

When export is invoked, the user will be presented with a default name for the file. This name will be uniquely determined from the Family Name and extensions of Wxy for Near Wake files, Dxy for Dispersion files, and Txy for Total Accountancy files. "xy" are the numbers 01, 02, etc. as needed. This notation is consistent with the Near Wake trajectory files (Bxy) and the plot files (Pxy). The user will also have to keep track of the information each file contains.

SPRAYMAZE

Since time cannot be spent exclusively on FSCBG simulations (otherwise we might be thought of as "spray nerds"), this version of FSCBG offers a maze game that pits you (the pesticide application expert) against an insect (the computer), in a battle to reach an endangered plant species first. Each maze is randomly generated, and you can read the rules and take your chances (as well as the next spray nerd).

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